

color it is unevenly blotched white and horn color, a few examples opaquely white. When blotched or mottled, the cords and growth wrinkles are often white, thus intensifying the contrast between the two colors. Spire elevated, whorls depressed and sharply carinated. Spiral cords from 5 to 9, with two strong cords or one strong cord between two smaller cords, above the periphery. Fine spiral striae between cords, strongest on the under surface. Growth wrinkles strong, 2 to 6 per mm., a large wrinkle about every one and one-half mm. gives the under surface a checkered effect. Whorls  $4\frac{1}{2}$ , umbilicus small, funnel-shaped, not cylindrical, all whorls visible to the apex. Embryo whorls  $2\frac{1}{2}$ , darker-colored, smoother than later whorls but plainly marked by spiral cords and oblique growth wrinkles. Mouth oblique, and in older individuals lip sometimes stained yellow. In the aged the last whorl often drops half below the periphery.

Alt. 10, diam. 17.5 mm. (No. 112918a, A. N. S. P.)

“ 11, “ 18 mm.

Type specimens in my own collection and in the Academy of Natural Sciences of Philadelphia.

These shells had an enemy which broke an irregular hole in the upper surface of the shell, about 2 mm. in diameter. I have not noticed this form of destruction in other colonies of land shells.

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**THE NATURE OF THE CONICAL BODIES ON THE MANTLE OF CERTAIN NUDIBRANCHS.**

BY W. J. CROZIER.

Contributions from the Bermuda Biological Station for Research, No. 57.

A study of the supposed “warning” coloration of brilliantly pigmented nudibranchs as represented by *Chromodoris zebra* Heilprin, has incidentally made clear the previously unknown significance of the “white conical bodies” which occur on the posterior ventral surface of the mantle of this species and give it a beaded appearance. Since white nodular structures of a presumably similar character have been noted upon the mantle

edge of other tropical nudibranchs, the function of these organs as worked out in *C. zebra* is probably identical among all the species in which they occur.

The bodies in question are in fact glands, which store a special secretion concerned in protecting the nudibranchs from the attacks of preying enemies. They are, in a functional sense, comparable to the repugnatorial glands of the littoral pulmonate *Onchidium*, although their mode of action is different. They occur, usually 5, 6 or 7 in number, immediately over the "tail." In some instances 10, 12, and even as many as 19, of these organs have been noted. The manner of their distribution strongly suggests that 5, and in some cases 7, specialized regions exist which give rise each to one of the conical bodies. The central gland of the 5 or 7 is situated in the median plane of the body. It is significant that the increased number of the organs, when they exceed 7, is usually (if not invariably) associated with some injury, such as would be occasioned by the bite of a fish, which has removed a portion of the gland-forming area of the mantle.

Not all the bodies on a single animal are of the same size, one or more being sometimes quite minute. The definite pattern according to which they are arranged is preserved even in cases where one or more of the glands is totally suppressed.

Each of the glands is provided with a pore. In rare cases two pores have been found upon a single gland. The pores are surrounded by a sphincter. When *Chromodoris* is violently disturbed in any way, its consistent reaction is to withdraw the gills and rhinophores, to erect the lateral edge of the mantle, and to turn under, ventrally, the posterior part of the mantle bearing the glandular organs. At the same time the glands become turgid, through the contraction of their muscular investment, the pores being then more prominent. If the irritating stimulation is continued, there issues from the pores of one or more of the glands a white creamy secretion, which is not dissolved by sea water. It is composed mainly of globules of an oily substance. The secretion is not acid, but is neutral to litmus.

When the glands are stimulated individually with induction

shocks, they respond by pouring out their secretion, and the same reaction occurs, on stimulation, when the portion of the mantle which bears them is detached from the rest of the animal.

Chromodoris behaves with reference to these organs in such a way as to point to their importance in the animal's economy. The characteristic ventralward inbending of this portion of the mantle, so different from the boldness with which its lateral borders are thrown into prominence when the creature is disturbed, inevitably suggests a reflex of a protective kind. The nature of the conditions which determine their discharge leads one to regard the glands as repugnatorial in function. Careful study of the results of feeding these mollusks to fishes and various invertebrates has demonstrated that these bodies cannot, however, represent the sole source of offensive secretions. A repulsive material, histologically and microchemically resembling that found in the conical glands, constitutes in fact part of the secretion which proceeds from the whole integument of Chromodoris, but particularly from the lateral portions of the mantle. It is noteworthy that in many individuals there are to be observed, especially over the region of the mouth and tentacles, minute white bodies occurring on portions of the ventral mantle surface remote from the conspicuous white papillae. These bodies also give rise to the white secretion. Such facts lead one to consider that the glands at the posterior end of the animal are merely the expression of a specialized development of the repugnatorial function which is the common property of the whole dorsal and lateral integument. The exposed location of the papillae also negatives the supposition that the glands may be the primary seats for the elaboration of the repugnatorial material, to be secondarily transported to other regions of the animal's surface. As a matter of experimental test, these nudibranchs when totally deprived of the beaded area of the mantle remain unimpaired in their ability to develop a protective distastefulness for fishes and invertebrates.

The repulsive character of the contents of the glands is readily established by controlled feeding tests in which food fragments are smeared with the secretion. Such morsels are invariably rejected. It remains doubtful, however, if this emulsion

of substances represents the only repugnatorial material possessed by *Chromodoris*. It seems possible that the oily element of the secretion is particularly involved in the production of the curiously penetrating odor which the nudibranch emits, and that some other substance is also concerned in determining the general distasteful quality.

Incidentally, the glands cannot be implicated in any mutual attraction between individuals at the time of pairing, for animals from which the glandular equipment has been completely removed, are found to mate readily and deposit normal egg masses.

I have commented above on the suggestive appearance of protection evidenced by the inturning of the posterior beaded border of the mantle. A closer analysis shows, however, that any protection which is in this way afforded to the conical glands is purely incidental. For if the projecting "tail" of the nudibranch is stimulated (as with induction shocks), the beaded portion of the mantle is not rolled under upon itself, but is spread out so that the openings of the glands point in the general direction of the irritated area. Their discharge under these circumstances may occasionally be seen. I therefore believe that the ventralward inflection of the gland-bearing portion of the mantle is primarily a reaction having to do with the normal discharge of the glands. When the nudibranch is attacked at the side, or anteriorly, the glands are thus given an opportunity to discharge a part of their contents in an appropriate direction.

A full account of these observations will be published later.

*Agar's Island, Bermuda.*

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THE ANATOMY OF *CONTRADENS CAMBOJENSIS* (SOW.) (NAYADES).

BY DR. A. E. ORTMANN.

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Two specimens, male and gravid female, from Petchaburi, Siam, are at hand, received from B. H. Bailey, and collected by Dr. E. B. McDaniel.

These specimens agree very well with *Unio cambojensis* Sow-erby (Conch. Icon. 18. Unio. 1866, pl. 42, f. 231), in general